October 22, 2001

Memorandum

To: Accuracy Working Group List (see attached list)

From: Mike Paglione, *FAA ACT-250*

Date: 10/22/2001

Re: **False Alert Analysis of User Request Evaluation Tool Daily Use System Aircraft to Aircraft Conflict Predictions for Inter-facility Accuracy Runs, Rev1**[1]

Scope

For the formal User Request Evaluation Tool Core Capability Limited Deployment (URET CCLD) accuracy testing, false alert aircraft to aircraft conflict prediction accuracy requirement values (i.e. CIA1009 through CIA1018) were originally refreshed in December 2000. Later in July 2001, a problem was uncovered in a MITRE CAASD software tool that calculated these values. This prompted an update in the false alert measurements from MITRE CAASD and an FAA refresh of the specification with the corrected values for the Single Site Formal Accuracy Test in August 2001[2]. This memorandum will present analogous corrected false alert requirements for the Inter-Facility Site Formal Accuracy Test. In addition, ACT-250 will discuss three alternative methods of calculating the false alert requirements.

Results

Table 1 presents the original current plan false alert counts calculated back in December 2000. Table 2 includes the additional current plan false alerts incorrectly discarded in the original counts. Therefore, the sum of Table 1 and 2 is the total false alert counts partitioned by actual horizontal separation of the aircraft. The summation of Table 1 and 2 is included in Table 3 and represents the total false alert counts for the current plan inter-facility (IFA) requirements. Table 4 contains the aircraft to aircraft encounter counts (non-conflict events) for the various horizontal bins.

For Method 1 the false alert requirement is calculated by Equation 1, where the false alerts per requirement bin is the numerator and the denominator is the number of corresponding encounter pairs. Retracted false alerts are included in the first bin's numerator (i.e. CIA1009). Unmatched false alerts are included as the numerator in a separate calculation but associated with CIA1012.

$$\text{Method 1 False Alert Ratio} = \frac{\sum \text{false alerts}_{bin}}{\sum \text{encounter pairs}_{bin}} \qquad (1)$$

[1] This memorandum was revised based on the consensus reached during teleconference on 10/22/01 between AST, MITRE, LMATM, and ACT-250 participants.

[2] Refer to Memorandum by Mike Paglione, FAA ACT-250, "Single Site URET CCLD Accuracy Refresh Parameters," 8/30/01

Using Method 1's Equation 1, the current plan false requirements are listed in Table 6. For Table 6's current plan requirement values, the false alert counts in Table 3 and the encounter counts in Table 4 represent the numerator and denominator in Equation 1, respectively.

The Method 2 of calculating the false alert requirements is a slight modification of Method 1 in some of the bins. For Method 2, the retracted false alerts are included in the denominator in the first bin (i.e. CIA1009), and the unmatched false alerts are included in the denominator in the last bin (i.e. CIA1012). This is quantified for the current plan requirements in Table 7.

Method 3 is an alternative technique of calculating the false alert requirements, and the method used in previous specification refresh. Equation 2 is used for Method 3. The numerator is the number of false alerts for each horizontal separation bin and the denominator is the number of false alerts plus the number of correct no-calls. A correct no-call or missed false alert is the event where an encounter (non-conflict) is not matched with an alert. Thus, a correct no-call represents the situation where the conflict probe correctly did not present an alert for a particular encounter. For Method 3, the retracted and unmatched false alerts are treated in the same manner as Method 2.

$$\text{Method 3 False Alert Ratio} = \frac{\sum \text{false alerts}_{bin}}{\sum (\text{false alerts} + \text{corret no-calls})_{bin}} \qquad (2)$$

Table 5 includes the count of correct no-call events for each actual horizontal separation bin. Table 8 applies Equation 2 for the current plan false alert requirements.

Tables 9 through 16 present the trial plan false alert requirements (i.e. CIA1015 through CIA1018) in an analogous manner as the current plan requirements in Tables 1 through 8.

Conclusion

This study provides the reader with direct measurement performance of URET Daily Use aircraft to aircraft false alert predictions for all six inter-facility accuracy scenarios. This includes both current and trial plan requirements. The results presented will be used for the final refresh of the Inter-Facility Formal Accuracy Test specification requirements.

This study also presents three methods of calculating the false alert requirements. All three methods produce very similar results and use the same numerators for each. Method 1 is the simplest technique, since it just uses the number of actual encounters for each corresponding denominator. Method 2 includes the retracted and unmatched false alerts in the denominator as well as the encounter counts as in Method 1. Method 1 is the same technique used to calculate aircraft to airspace false alert requirements. It is also the reported technique used in OFPD. Method 3 is probably the most correct technique from a probability standpoint. However, it is the hardest to calculate, since Method 3 needs the correct no-calls to be tallied.

Another observation noticed during the analysis is the magnitude of correct no-calls in Tables 5 and Table 13. For example, it was originally expected that the sum of the number of correct no-calls in Table 5 and the corresponding false alerts in Table 3 would be greater than the number of encounters in Table 4. In the data, the opposite seemed to occur. For example the current plan 1100_1600 scenario false alerts plus number of correct no-call events amounted to 4,042. This is obviously less than the 4,223 total count of encounters in Table 4. This issue was discussed with MITRE CAASD (W. Arthur) and is explained by the discarded false alerts. In other words, a number of matching false alert and encounters are discarded due to the various false alert rules. These discarded false

alerts explain why the sum of false alerts and correct no-calls is not larger than the quantity of encounters.

ACT-250 discussed these results with Advanced System Technologies, MITRE CAASD, and Lockheed Martin system engineers during a teleconference on the morning of 10/22/01. A consensus was reached on the proper method to use for the inter-facility specification refresh. Since all three methods produce very similar results, the discussion was short and concluded with using the method with the least cost, namely Method 1. Method 1 was confirmed to be the technique supported by Lockheed Martin's OFPD software and will be used to measure URET CCLD during the Inter-Facility Formal Test.

Also, it was agreed that the false alert requirement values would be refreshed to the thousandth place. This would minimize any differences between the specification and the values calculated for URET CCLD during the Formal Test. This is reflected in the average column in Tables 6, 7, 8, 14, 15, and 16.

Table 1: IFA Current Plan False Alert Original Counts[3]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1009 0 >= MinH < 10	220	234	265	243	227	283
CIA1010 10 >= MinH < 15	48	25	29	32	36	43
CIA1011 15 >= MinH < 23	11	14	17	16	20	17
CIA1012 23 >= MinH	5	2	1	5	4	5
Total	284	275	312	296	287	348
Unmatched	16	24	18	15	20	24
Retracted	16	27	18	14	24	19

Table 2: IFA Current Plan False Alert Corrections[4]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1009 0 >= MinH < 10	26	16	25	10	30	20
CIA1010 10 >= MinH < 15	11	4	7	5	8	8
CIA1011 15 >= MinH < 23	1	9	5	7	7	9
CIA1012 23 >= MinH	1	3	2	3	1	1
Total	39	32	39	25	46	38
Unmatched	6	6	4	12	6	10
Retracted	7	4	4	1	1	4

[3] Source data from MITRE CAASD delivered compact disk, labeled #467.
[4] Source data from MITRE CAASD email, William Arthur, 8/1/01.

Table 3: IFA Current Plan False Alert Totals (i.e. Original + Corrections)

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1009 0 >= MinH < 10	246	250	290	253	257	303
CIA1010 10 >= MinH < 15	59	29	36	37	44	51
CIA1011 15 >= MinH < 23	12	23	22	23	27	26
CIA1012 23 >= MinH	6	5	3	8	5	6
Total	323	307	351	321	333	386
Unmatched	22	30	22	27	26	34
Retracted	23	31	22	15	25	23

Table 4: IFA Current Plan Aircraft-Aircraft Encounter Counts (non-conflicts)[5]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1009 0 >= MinH < 10	1185	1164	1272	1150	1146	1301
CIA1010 10 >= MinH < 15	710	716	725	704	741	869
CIA1011 15 >= MinH < 23	1271	1249	1344	1188	1228	1468
CIA1012 23 >= MinH	1057	1065	1115	1060	1094	1359
Total	4223	4194	4456	4102	4209	4997

[5] Source data from IFA merge files on ACT-250 delivered compact disk, labeled “Final Accuracy Scenario Delivery, Refresh Data, Revision 1, November, 2000.”

Table 5: IFA Current Plan Correct No-Call Counts[6]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1009 0 >= MinH < 10	940	937	1005	885	914	1047
CIA1010 10 >= MinH < 15	607	621	640	606	629	764
CIA1011 15 >= MinH < 23	1193	1162	1265	1093	1156	1372
CIA1012 23 >= MinH	1018	1031	1094	1019	1050	1316
Total	3758	3751	4004	3603	3749	4499

Table 6: Method 1 Current Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1009 0 >= MinH < 10	0.2270	0.2414	0.2453	0.2330	0.2461	0.2506	0.241
CIA1010 10 >= MinH < 15	0.0831	0.0405	0.0497	0.0526	0.0594	0.0587	0.057
CIA1011 15 >= MinH < 23	0.0094	0.0184	0.0164	0.0194	0.0220	0.0177	0.017
CIA1012 23 >= MinH	0.0057	0.0047	0.0027	0.0075	0.0046	0.0044	0.005
Unmatched	0.0208	0.0282	0.0197	0.0255	0.0238	0.0250	0.024

[6] Also referred to as "MISSFA" from source data on MITRE CAASD delivered compact disk, labeled #467.

Table 7: Method 2 Current Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1009 0 >= MinH < 10	0.2227	0.2351	0.2411	0.2300	0.2408	0.2462	0.236
CIA1010 10 >= MinH < 15	0.0831	0.0405	0.0497	0.0526	0.0594	0.0587	0.057
CIA1011 15 >= MinH < 23	0.0094	0.0184	0.0164	0.0194	0.0220	0.0177	0.017
CIA1012 23 >= MinH	0.0056	0.0046	0.0026	0.0074	0.0045	0.0043	0.005
Unmatched	0.0204	0.0274	0.0193	0.0248	0.0232	0.0244	0.023

Table 8: Method 3 Current Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1009 0 >= MinH < 10	0.2225	0.2307	0.2369	0.2324	0.2358	0.2374	0.233
CIA1010 10 >= MinH < 15	0.0886	0.0446	0.0533	0.0575	0.0654	0.0626	0.062
CIA1011 15 >= MinH < 23	0.0100	0.0194	0.0171	0.0206	0.0228	0.0186	0.018
CIA1012 23 >= MinH	0.0057	0.0047	0.0027	0.0076	0.0046	0.0044	0.005
Unmatched	0.0210	0.0281	0.0197	0.0256	0.0241	0.0251	0.024

Table 9: IFA Trial Plan False Alert Original Counts[7]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1015 0 >= MinH < 10	217	241	273	239	239	291
CIA1016 10 >= MinH < 15	50	31	36	36	39	48
CIA1017 15 >= MinH < 24	16	20	24	18	25	25
CIA1018 24 >= MinH	4	2	0	3	4	3
Total	287	294	333	296	307	367
Unmatched	19	27	17	20	24	26
Retracted	20	27	18	14	21	22

Table 10: IFA Trial Plan False Alert Corrections[8]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1015 0 >= MinH < 10	27	22	32	14	35	22
CIA1016 10 >= MinH < 15	16	8	8	6	8	8
CIA1017 15 >= MinH < 24	2	13	10	10	13	14
CIA1018 24 >= MinH	2	5	6	5	0	1
Total	47	48	56	35	56	45
Unmatched	12	10	6	24	10	16
Retracted	6	7	8	1	3	6

[7] Source data from MITRE CAASD delivered compact disk, labeled #467.
[8] Source data from MITRE CAASD email, William Arthur, 8/1/01.

Table 11: IFA Trial Plan False Alert Totals (i.e. Original + Corrections)

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1015 0 >= MinH < 10	244	263	305	253	274	313
CIA1016 10 >= MinH < 15	66	39	44	42	47	56
CIA1017 15 >= MinH < 24	18	33	34	28	38	39
CIA1018 24 >= MinH	6	7	6	8	4	4
Total	334	342	389	331	363	412
Unmatched	31	37	23	44	34	42
Retracted	26	34	26	15	24	28

Table 12: IFA Trial Plan Aircraft-Aircraft Encounter Counts (non-conflicts)[9]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1015 0 >= MinH < 10	1185	1164	1272	1150	1146	1301
CIA1016 10 >= MinH < 15	710	716	725	704	741	869
CIA1017 15 >= MinH < 24	1436	1408	1503	1347	1405	1676
CIA1018 24 >= MinH	892	906	956	901	917	1151
Total	4223	4194	4456	4102	4209	4997

[9] Source data from IFA merge files on ACT-250 delivered compact disk, labeled "Final Accuracy Scenario Delivery, Refresh Data, Revision 1, November, 2000."

Table 13: IFA Trial Plan Correct No-Call Counts[10]

	SCENARI0					
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**
CIA1015 0 >= MinH < 10	926	911	989	876	899	1028
CIA1016 10 >= MinH < 15	593	606	634	592	622	739
CIA1017 15 >= MinH < 24	1338	1299	1402	1232	1308	1552
CIA1018 24 >= MinH	854	869	931	864	878	1112
Total	3711	3685	3956	3564	3707	4431

Table 14: Method 1 Trial Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1015 0 >= MinH < 10	0.2278	0.2552	0.2602	0.2330	0.2600	0.2621	0.250
CIA1016 10 >= MinH < 15	0.0930	0.0545	0.0607	0.0597	0.0634	0.0644	0.066
CIA1017 15 >= MinH < 24	0.0125	0.0234	0.0226	0.0208	0.0270	0.0233	0.022
CIA1018 24 >= MinH	0.0067	0.0077	0.0063	0.0089	0.0044	0.0035	0.006
Unmatched	0.0348	0.0408	0.0241	0.0488	0.0371	0.0365	0.037

[10] Also referred to as “MISSFA” from source data on MITRE CAASD delivered compact disk, labeled #467.

Table 15: Method 2 Trial Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1015 0 >= MinH < 10	0.2230	0.2479	0.2550	0.2300	0.2547	0.2566	0.245
CIA1016 10 >= MinH < 15	0.0930	0.0545	0.0607	0.0597	0.0634	0.0644	0.066
CIA1017 15 >= MinH < 24	0.0125	0.0234	0.0226	0.0208	0.0270	0.0233	0.022
CIA1018 24 >= MinH	0.0065	0.0074	0.0061	0.0085	0.0042	0.0034	0.006
Unmatched	0.0336	0.0392	0.0235	0.0466	0.0358	0.0352	0.036

Table 16: Method 3 Trial Plan False Alert Requirement Values

	SCENARI0						
False Alert Bin	**1100_1600**	**1200_1700**	**1300_1800**	**1400_1900**	**1500_2000**	**1600_2100**	**Average**
CIA1015 0 >= MinH < 10	0.2258	0.2459	0.2508	0.2343	0.2490	0.2491	0.242
CIA1016 10 >= MinH < 15	0.1002	0.0605	0.0649	0.0662	0.0703	0.0704	0.072
CIA1017 15 >= MinH < 24	0.0133	0.0248	0.0237	0.0222	0.0282	0.0245	0.023
CIA1018 24 >= MinH	0.0067	0.0077	0.0063	0.0087	0.0044	0.0035	0.006
Unmatched	0.0348	0.0405	0.0240	0.0480	0.0371	0.0363	0.037

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[11] Accuracy working group list includes all participants involved on URET CCLD accuracy measurement. Email sent to the ACT-250 email account, accuracy@tatca.tc.faa.gov, will be forwarded to everyone in the list.